CONSIDERATIONS ON THE PNEUMOCONIOTIC EFFECT OF DUST FROM MANGANESE ORE MINES[1]

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The dust from manganese compounds, affecting the lungs of workers under occupational conditions, is most frequently mixed up with other ingredients. This is the case of the dust aerosol in the production of ferrites (Bakalinskaya — 1968, Nechaeva — 1971) and dry electric pills (Dervillée and co-authors — 1966, Emara and co-authors — 1971), in electric welding (Razboynikov and co-authors — 1966, Patucek — 1970, Naumenko and Rapoport — 1970, Kolkovsky and co-authors — 1971), etc.

In manganese ore mines, the compounds of manganese in the dust aerosol are mixed up with various minerals (Kartman — 1956, Tuchenko — 1962, Folprechtova and co-authors — 1970), of which free silicon dioxide is the most aggressive. It promotes the development of pneumoconiosis in the affected workers, and along with that, manganese, in all likelihood, contributes to the modification of the pathologic process.

The pneumoconiotic effect of dust on the lungs of workers from an open mine for manganese production (the Pozharevo Mine) is studied.

The mine is comparatively small and work is done at 100 m depth which renders ventilation easier. There are good ventilation facilities, with water drilling and irrigation of the separated ore-rock mass being provided for.

Mainly oxide and hydrate ores are extracted from the mine, with mineral composition: pirolusite, psilomelan, psilomelan-vad, a small amount of polyanite, and very seldom — vanganite. The ore minerals are represented mainly by the following quartz variants: halcedon and opal, and less — calcite, rodohrozite, chlorite and sericite. The mean content of manganese in the ore amounts to 28.19 per cent. In the ore-bed zone the following rock variants are found: andesite, trachoandesite, andesite-basalts, tufomarl and sand-marl clays, etc.[2] The free silica content in the rock layers ranges from 25.4 to 46.7 per cent, or 33.2 per cent in the average.

Dust pollution of the mine atmosphere, controlled over a period of $3^1/_2$ years in the different working places, at various hours of the working day and in various working operations, using the gravimetric method, shows a fluctuation ranging from 0.20 to 5.0 mg/m^3, or mean 1.52 mg/m^3 from 206 samples (Table 1).

According to koniometric data, the dust pollution of the air during the different working manipulations shows 54 to 1352 (mean 174.8 from 45 sam-

[1] Report read at the International Meeting on Labour Hygiene — Slanchev Bryag, Bulgaria, 20—24. 9. 1971.

[2] Data are used, obtained from the Mine Administration.

Table 1

Some of the Result s of Investigating Air Dust Pollution According to the Gravimetric Method

Date of sample taking	Working p lace	Manipulations	Air t° C	Dust pollution of air in mg/m³
10. 1. 1968	coal-face 635—3	lading	14	4.1
31. 1. 1968	funnel 23	lading	13	1.2
8. 4. 1968	coal-face 30—95	lading	13	1.03
3. 9. 1968	coal-face 30—85—2	after drilling	13	1.4
3. 11. 1968	coal-face 635—4	lading	14	5.0
19. 12. 1968	gallery 24	transport	11	0.25
15. 4. 1969	traverse-south	lading	12	0.20
5. 8. 1969	traverse-east	support	16	0 70
20. 11. 1969	coal-face 635	drilling	13	2.4
29. 1. 1970	coal-face 629—2	lading	14	2.9
23. 11. 1970	coal-face 629—1	lading.	13	2.2
19. 2. 1971	gallery 93—2	lading	13	1.2
10. 6. 1971	coal-face 93—2	lading	14	1.4

ples) dust particles in air, at high dispersion of the dust — 92.58 per cent of the dust particles measured less than five microns. According to the standards adopted for dusts containing free silica from 20—50 per cent, the dust pollution established was equal or close to the maximum allowable concentration limit (11).

X-ray and clinico-laboratory examinations were conducted in a series of 47 underground workers with rather continuous dust exposure. Of them five were under 30 years of age, sixteen — 31 to 40 years, nineteen — 41 to 50 and seven were older than 50 years.

Signs for a dust effect on the lungs, manifested in varying degrees, were found in most of the workers under review (39), while in 23 the development of pneumoconiotic changes was in the state of Z control, and in 16 — in the state of 1 control. Pronounced pneumoconiosis with rather advanced pathological changes was not established. Wasserman and Mihail (1964), in the study of 927 miners, found manganoconiosis in more advanced stages. We failed to establish a definite dependence between the degree of changes, and the age of workers. However, such a correlation is present relative to the length of underground dust exposure of the miners, and more particularly, with the increase of working service, the number of workers with heavier changes increases, and the number of those with few or no changes decreases. Even suspected pneumoconiotic changes were never recorded upon dust exposure for less than three years. As anticipated, most of the pneumoconiotic changes are detected in miners working in the more dust-polluted sites — coal faces (diggers and their assistants).

The X-ray morphological picture displays mainly linear, diffuse sclerotic fibrosis, and even after 23-year-long dust exposure, the only modification is represented by a few nodular-like formations — mixed form (Table 2).

Table 2

X-Ray Morphological Signs

		No of studied cases (n)	Diffuse fibrosis	Mixed fibrosis	Reticular deformation	Pulm. lobe changes: middle	Pulm. lobe changes: lower	Pulm. lobe changes: middle+lower	Mostly right-side changes	Thickening of interlob. pleura	Emphysema	Basal emphysema
Evolution of pneumoconiot. changes	Without pneumoconiot. changes	8	—	—	—	—	—	—	—	—	4	6
	Control Z	23	19	4	15	6	4	13	5	3	16	14
	Control 1	16	1	15	12	2	1	13	5	4	14	9
Underground length of service	0—2 years	1	—	—	—	—	—	—	—	—	—	—
	3—5 years	11	5	2	2	2	1	4	2	1	7	8
	6—10 years	12	6	3	8	1	1	7	3	1	9	8
	11—15 years	18	6	12	12	3	2	13	4	4	16	10
	16—23 years	5	3	2	5	2	1	2	1	1	2	3
Age	up to 30 years	5	3	1	1	1	—	3	1	1	2	3
	31—40 years	16	8	8	13	3	1	12	3	3	13	11
	41—50 years	19	6	7	10	2	3	8	4	3	12	11
	above 50 years	7	3	3	3	2	1	3	2	—	7	4
Total		47	20	19	27	8	5	26	10	7	34	29
% (P±Sp)			42.5±7.2	40.4±7.1	57.4±7.2	17.0±5.4	10.6±4.4	55.3±7.2	21.2±5.9	14.8±5.1	72.3±6.5	61.7±7.0

Of the total number of 39 investigated cases, 20 display diffuse sclerotic changes, and 19 — a mixed type, while a reticular deformation of the pulmonary outline (reticular form) is observed in 27 cases. The pneumoconiotic changes involve more frequently the middle and lower pulmonary fields (26 of the total number), and rather rarely — the middle or inferior pulmonary field alone. Pneumosclerosis of the upper pulmonary lobes only, pathoanatomically established by Hibin (1967) in a manganese and ferromanganese miller, is in disagreement with our finding.

In the cases of the series, the changes are more pronounced in the right lung, and this sign shows no correlation with the age and dust exposure service of the workers. A thickening of the interlobar pleura is observed in seven cases.

Pulmonary emphysema (in 34 of the total number of 47 workers — 72.3± 6.6 per cent) and basal pulmonary emphysema (in 29 cases — 61.7±7.0 per cent) are frequent concomitant conditions in pneumofibrosis. These changes depend on the age and occupational dust exposure of the workers. Anyway, they may be also observed in workers presenting no other pneumoconiosis signs, which points to the fact that emphysema may be a condition preceding pneumoconiosis. The study of the blood picture and skin allergic response to tuberculin did not reveal characteristic changes.

In the course of functional studies on external respiration, it was established that the vital capacity is preserved within normal values in most of the examinees (in 35 of 46 cases investigated). However, rather frequently, the dynamic indicators of pulmonary ventilation were disturbed: forced expiratory volume — in 18 of 29 cases, and the air velocity index — in ten. This suggests a prevalence of obstructive pathological changes in the pulmonary ventilation over restrictive ones. Penkovich and co-authors (1970) found out that in pneumoconiosis the disorders in pulmonary ventilation are related not as much to the spreading of sclerotic changes, as to bronchial conductivity impairment due to the concomitant chronic bronchitis.

Conclusions

Over the past 3 1/2 years, dust pollution of the air in the mine under investigation was more frequently within normal hygiene limits — mean 1.52 mg/m³ and 174.8 dust particles per milliliter air. This is a probable explantation of the fact that despite the rather significant free silica content (25.4—46.7 per cent), the effect of dust on the lungs of the workers caused merely initial pneumofibrosis with mainly diffuse-sclerotic, and to a lesser degree — mixed character. Pneumoconiotic changes run a course of slow evolution, and even after 28-year-long dust exposure, they remain in the clinical stage of pneumoconiosis, without reaching the nodular form of the disease.

The functional study on external respiration shows mostly disorders in the dynamic indicators, and ventilatory changes of obstructive type as well.

The assumption is warranted that manganese compounds, mixed up with the dust, have contributed to the peculiar evolution and form of the pulmonary disorders observed.

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К ВОПРОСУ О ПНЕВМОКОНИОТИЧЕСКОМ ДЕЙСТВИИ ПЫЛИ ИЗ ШАХТ ДЛЯ МАРГАНЦЕВОЙ РУДЫ

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РЕЗЮМЕ

Прослежено пневмокониотическое действие пыли на легкие 47 подземных работников в руднике для добывания марганцевой руды. У 39 из них установлены признаки пылевого воздействия на легкие. У 23 — это пневмокониотические изменения в состоянии контроля и у 15 — в контроле 1. Налицо корреляция между изменениями и подземным стажем рабочих. Рентгеноморфологическая картина показывает развитие преимущественно линейного диффузно-склеротического фиброза. При функциональном исследовании преобладают обструктивные патологические явления в легочной вентиляции перед рестриктивными. Вероятно соединения марганца, в смеси с кремниевой пылью, оказали влияние на особую эволюцию и форму наблюдаемых изменений в легких.